

***Certified
Naval Battle Groups***



Aegis

From MIL-SPEC to Open Systems

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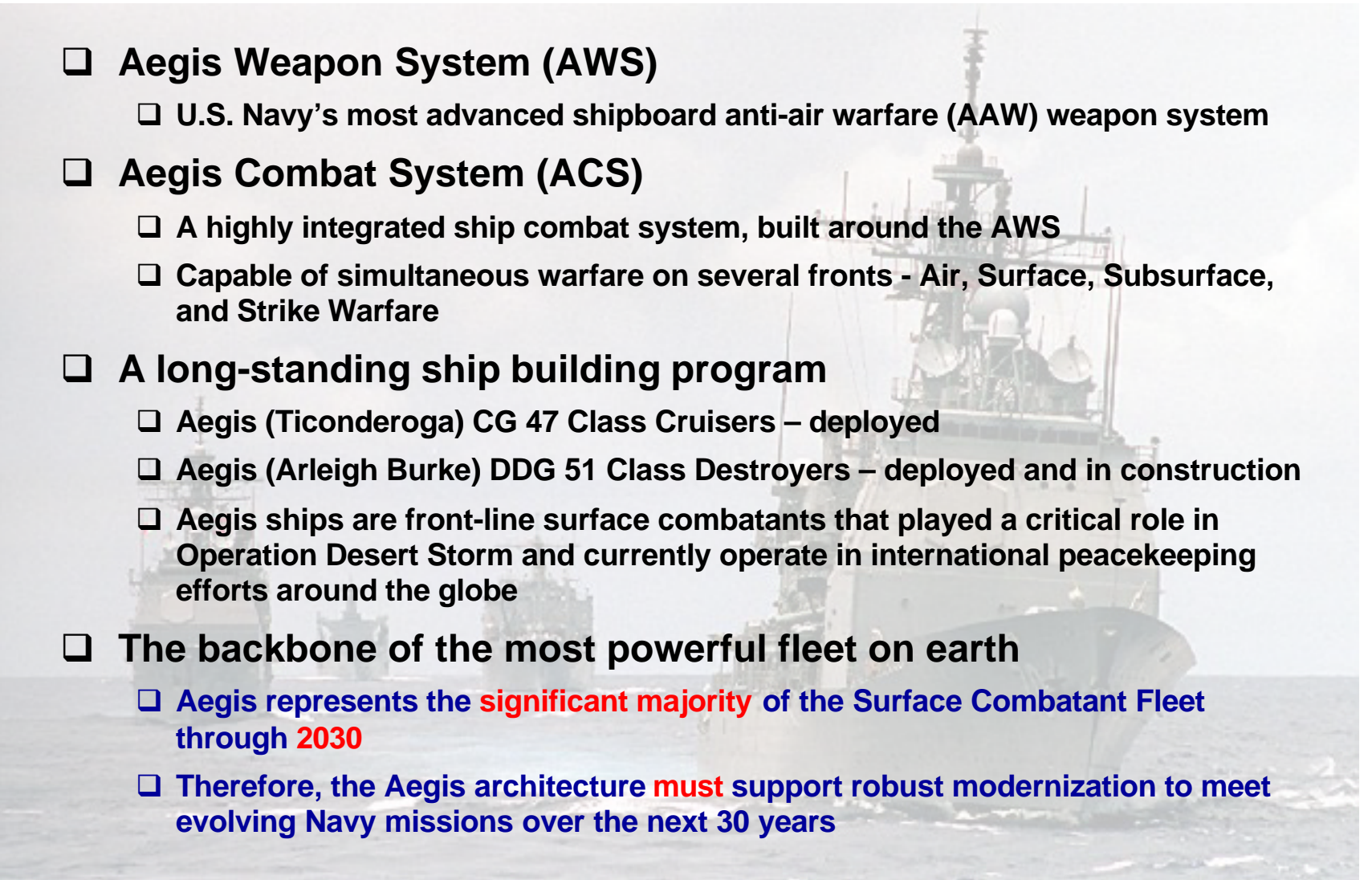
Outline

- ☐ What is Aegis?
- ☐ Aegis philosophy
- ☐ Aegis baseline development
- ☐ Aegis combat system configuration
- ☐ Aegis technology evolution
- ☐ Complete the paradigm shift
- ☐ Aegis requirements for open architecture
- ☐ Navy Open Architecture (NOA)

Executive Summary

- ☐ Aegis ships are front-line Navy surface combatants that form the backbone of the most powerful fleet on Earth
- ☐ Many baselines (versions) of the Aegis Combat System (ACS) have been successfully developed and deployed
- ☐ The Aegis Weapon System [(AWS) – the core around which the ACS is integrated] has made the transition to commercial technology in terms of computers, operating systems, programming languages - but has not made the transition to an open systems architecture for the tactical computer programs
- ☐ The Navy has a plan for achieving an open architecture for the AWS

Aegis Is . . .

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- ☐ **Aegis Weapon System (AWS)**
 - ☐ U.S. Navy's most advanced shipboard anti-air warfare (AAW) weapon system
 - ☐ **Aegis Combat System (ACS)**
 - ☐ A highly integrated ship combat system, built around the AWS
 - ☐ Capable of simultaneous warfare on several fronts - Air, Surface, Subsurface, and Strike Warfare
 - ☐ **A long-standing ship building program**
 - ☐ Aegis (Ticonderoga) CG 47 Class Cruisers – deployed
 - ☐ Aegis (Arleigh Burke) DDG 51 Class Destroyers – deployed and in construction
 - ☐ Aegis ships are front-line surface combatants that played a critical role in Operation Desert Storm and currently operate in international peacekeeping efforts around the globe
 - ☐ **The backbone of the most powerful fleet on earth**
 - ☐ Aegis represents the **significant majority** of the Surface Combatant Fleet through **2030**
 - ☐ Therefore, the Aegis architecture **must** support robust modernization to meet evolving Navy missions over the next 30 years

Aegis Philosophy

- ☐ Total combat systems engineering approach
- ☐ Cradle to grave responsibility
- ☐ Lifetime training and engineering agent
- ☐ Maintain and enhance key performance factors with upgrades
- ☐ Forward fit before backfit
- ☐ System engineering approach to modernize and solve problems
- ☐ Management teamwork: Aegis program office, government activities, and contractors
- ☐ Class control of characteristics and configuration
- ☐ Advanced planning on opcycle basis
- ☐ High operational availability of ships; keep industrial availabilities on time

“Build a little, test a little, learn a lot”

[illegible]

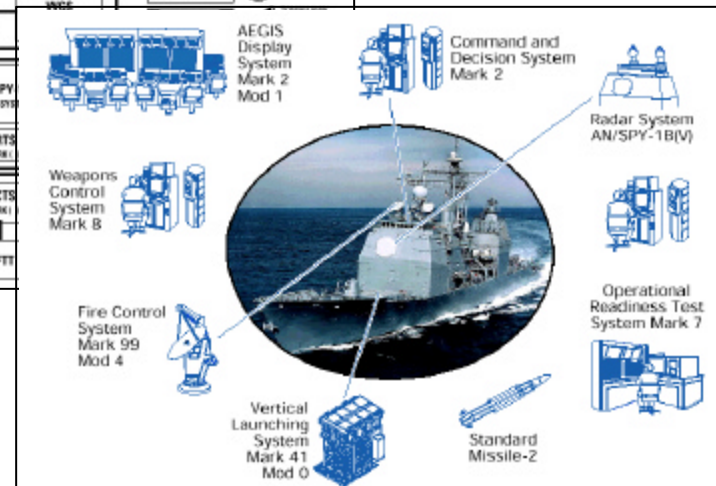
Total Ship

Diagram illustrating the components of a ship's structure, including:

- IDENT
- ELC
- WARP
- AMS
- SLM
- 9
- TOWED
- SPREAD
- SEA-SINK

- ❑ The application of scientific and engineering efforts to transform operational needs into system engineered warfighting upgrades
- ❑ This is achieved through:
 - ❑ Top-down requirements definition
 - ❑ Functional analysis & allocation
 - ❑ Design optimization
 - ❑ Code & equipment development
 - ❑ Test and evaluation
 - ❑ Certification

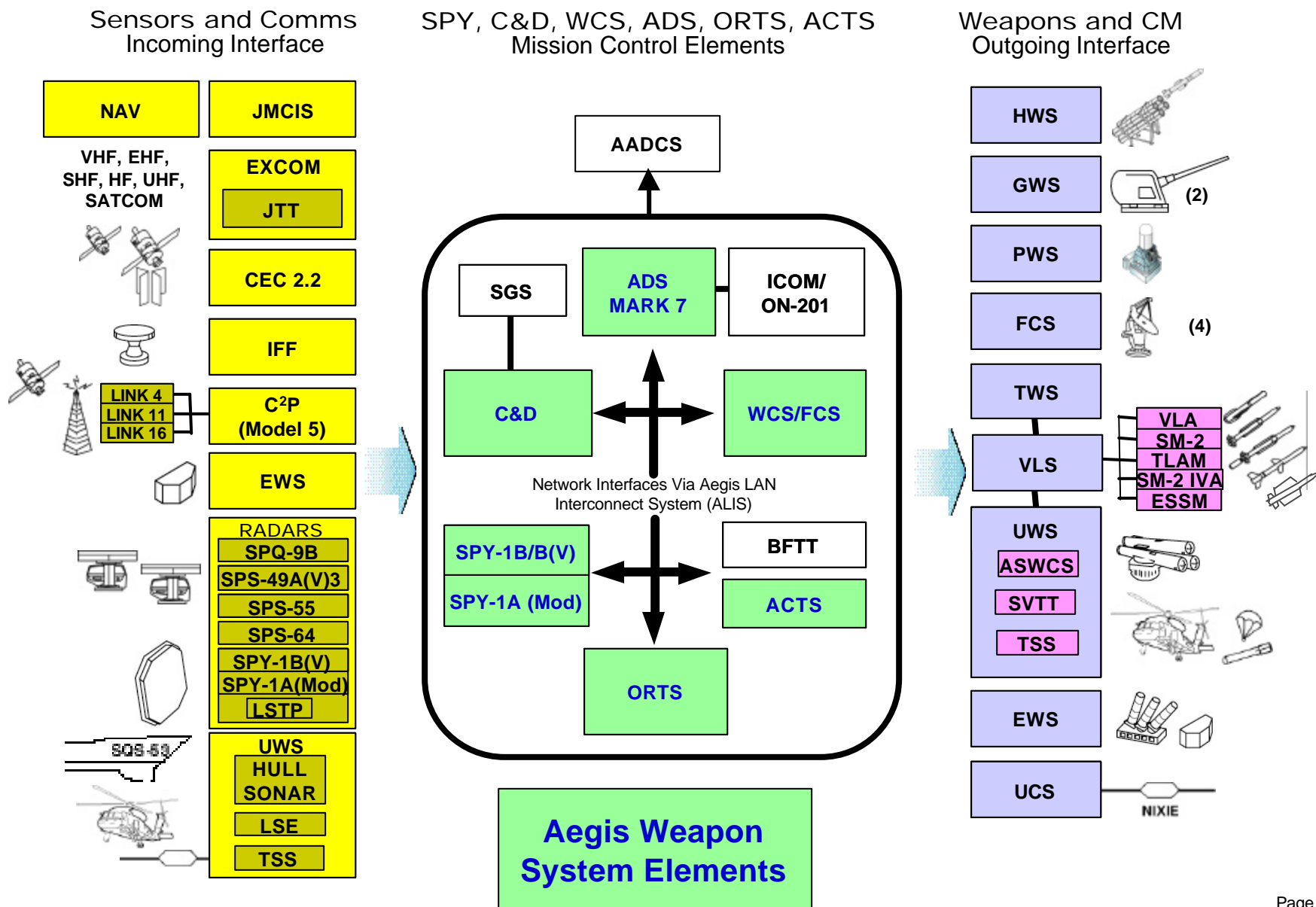
Weapon System







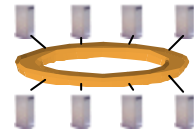
Aegis Baseline Development Philosophy

- ☐ New warfighting capability introduced incrementally
- ☐ Computer program designed and developed as superset and integrated with new equipment developments
 - ☐ Applicable to both cruisers and destroyers
 - ☐ Enables backward compatibility to earlier ships
- ☐ Combat system baseline programs and equipment undergo rigorous land-based and at-sea testing
- ☐ Weapon systems certified for
 - ☐ Safety of ordnance
 - ☐ Safety of personnel
 - ☐ Operational suitability
- ☐ Each baseline includes its own:
 - ☐ Development
 - ☐ Test
 - ☐ Production
 - ☐ Training
 - ☐ Ship integration
 - ☐ Lifetime support
 - ☐ Backfit implications

Example of Aegis Combat System Configuration



Aegis Technology Evolution

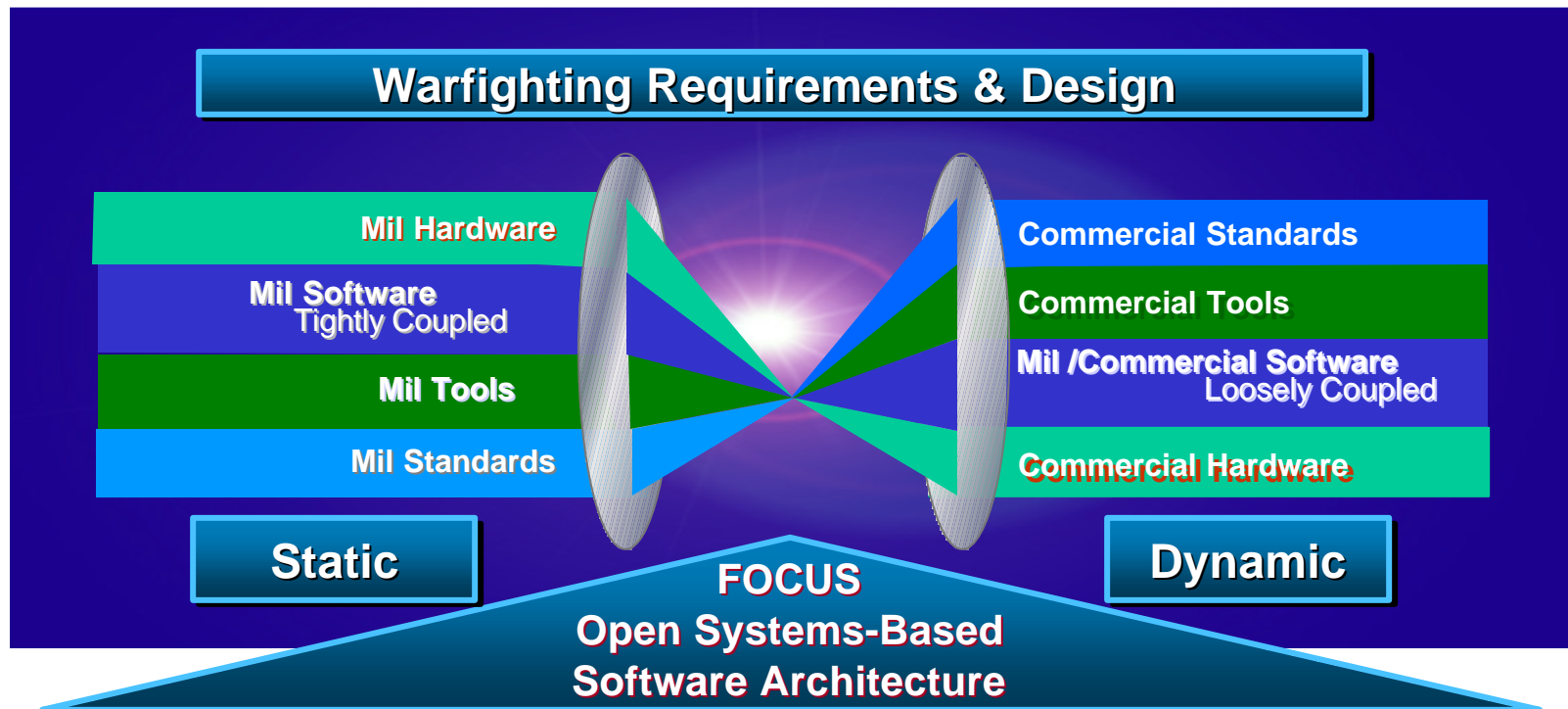
Baseline	B/L 1/2/3	B/L 4/5	B/L 6 Phase I	B/L 6 Phase III	B/L 7 Phase I
Time Frame	1980-1990	1990-1996	1997-1999	1999-2001	2001-2003
Delivery Ships	CG 47-64	DDG 51-78 CG 65-73	DDG 79-84 CG 66 & 69	DDG 85-90	DDG 91-107
					
	MIL SPEC Design	MIL SPEC Design	Mixed COTS and MIL SPEC Design	Mixed COTS and MIL SPEC Design	All COTS computers
Processor	UYK-7 UYK-20	UYK-43 UYK-44	UYK-43/44+ Adjunct COTS	UYK-43/44+ Adjunct COTS	COTS
Software	CMS-2	CMS-2	CMS-2 C++ Ada	CMS-2 C++ Ada	C++ Ada
Tactical S/W Size (relative, SLOCS)	1	3X	4.5X	5X	5.2X

Successful history of baseline development underpinned by . . .

- Bounding risk against new ship construction schedules
- Continue meeting operational requirements while introducing new warfighting capabilities & missions
- Affordability

Complete the Paradigm Shift

- ❑ **AWS is on an evolutionary path to an Open Architecture**
 - ❑ Current baseline in development (Baseline 7 Phase I) uses standards based hardware & commercial OS
 - ❑ However – AWS application computer programs have not moved beyond the shared memory architecture of MIL-SPEC (UYK-43/44)
 - ❑ Not modular or portable
 - ❑ Limits ability to maintain and upgrade the system
 - ❑ Limits system performance
 - ❑ Next step is to re-architect the AWS computer programs



Aegis Requirements for Open Architecture

- Improve extensibility for introducing new warfighting capabilities (threat evolution)
- Reduce development time
- Reduce maintenance cost
- Affordably manage COTS obsolescence
- Improve Human System Integration
- Maintain/exceed existing performance (i.e. cornerstones) →

AEGIS CORNERSTONES

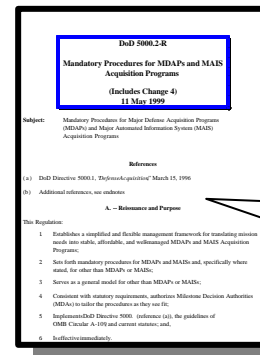
(key performance factors)

- ✓ Reaction time
- ✓ Firepower
- ✓ ECM and Environmental Resistance
- ✓ Continuous Availability
- ✓ Coverage

Vision Statement

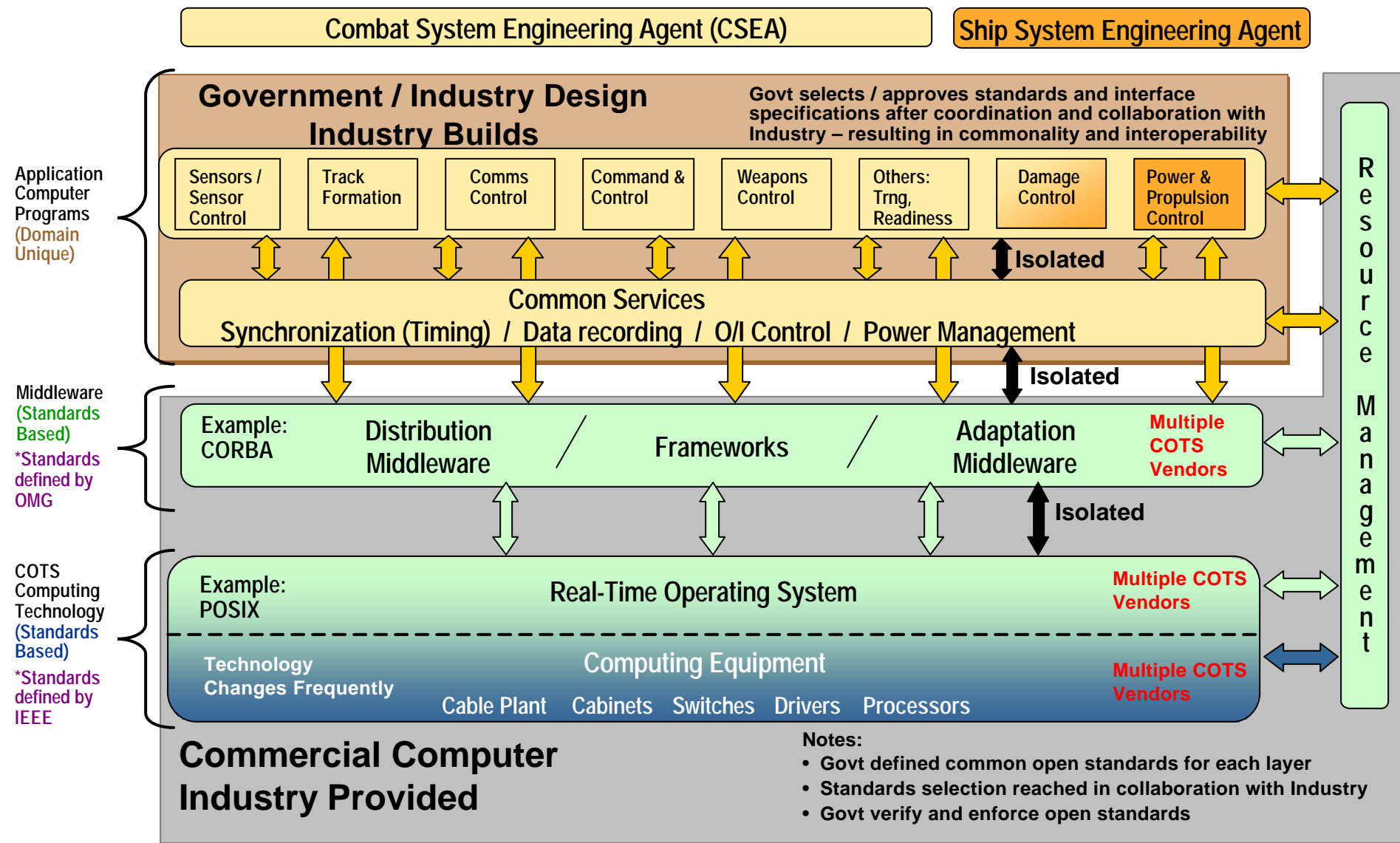
Using an open system distributed architecture, re-engineer the Aegis Weapon System (AWS) to be more capable, more reliable, and more adaptable to warfighting needs and technology change.

DoD Mandatory Procedures for Major Defense Acquisition Programs (5000.2R) (recently canceled)



PMs shall devise an **open systems strategy** focusing on fielding superior warfighting capability more quickly and more affordably by using **multiple suppliers** and **commercially supported** practices, products, specifications, and standards, which are selected based on performance, cost, **industry acceptance**, **long term availability** and **supportability**, and **upgrade potential**.

NOA Technical Architecture



Summary

- ❑ **Current surface ship computing systems are performance limited and expensive to upgrade**
- ❑ **Real-time Open Systems Architectures are feasible and can provide the cost-effective performance the surface fleet requires**
- ❑ **Navy has a plan for the way ahead for open systems architecture... to address affordability, interoperability, and performance**

